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IN THE U.S. PATENT AND TRADEMARK OFFICE

Appl. No.: 10/735,053

Applicant/Appellant: Pingali et al.

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Examiner: Sever, Andrew T.

Docket No.: YOR920030551US1

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Title: A SYSTEM AND METHOD FOR POSITIONING PROJECTORS IN SPACE TO
STEER PROJECTIONS AND AFFORD INTERACTION

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AMENDED APPELLANT'S BRIEF ON APPEAL

This Amended Appeal Brief is being submitted in response to the Notification of Non-Compliant Appeal Brief mailed August 29, 2006, regarding an appeal from the Final Office Action mailed December 29, 2005.

If there are any deficiencies in payment, please charge deposit account no.: 50-0510 for any deficiency.

(1) REAL PARTY IN INTEREST

The real party in interest (RPI) is International Business Machines Corporation of Armonk, New York, as indicated in an assignment of the U.S. application.

(2) RELATED APPEALS AND INTERFERENCES

There are no other pending appeals or interferences of which the undersigned representative and assignee/RPI is aware that will directly affect, be directly affected by or have a bearing on the Board's decision in this appeal.

(3) STATUS OF CLAIMS

Claims 1-13 and 15-40 are pending in this appeal and stand finally rejected. Claims 1-13 and 15-40 are reproduced in an Appendix accompanying this Brief as those claims stood finally rejected by a final Office Action dated December 29, 2005.

(4) STATUS OF AMENDMENTS

A Response under 37 C.F.R. §1.116 was submitted subsequent to the Final Rejection dated December 29, 2005. The Response Under 37 C.F.R. §1.116 was filed on March 24, 2006, and made argument but no claim amendments.

(5) SUMMARY OF CLAIMED SUBJECT MATTER

Reference may be had to FIGS. 4-9 for this Summary. Independent claim 1 is directed to a positioning system (50) (page 9, line 1) including at least one mount (page 9, lines 1-2) for mounting a projection unit (5) (page 8, lines 23-24) wherein the projection unit is comprised of at least a projector (3) (page 8, lines 23-24) for projecting a distorted image (16) (page 9, lines 22-23) and wherein the at least one mount (52) is coupled to a mechanism (54) (page 9, lines 3-5) for providing translational movement and rotational movement (page 7, lines 18-23) for adjusting one of a position and an orientation of the projection unit to produce from the distorted image (16) a substantially undistorted image (11) (page 9, line 31 – page 10, line 2) on a surface (12) (page 10, lines 16-17).

Independent claim 24 is directed to a method for providing a substantially undistorted image (11) (page 9, line 31 – page 10, line 2) upon a surface (12) (page 10, lines 16-17). The method includes sensing a request from a user (1) (page 8, lines 15-16) for a projection at a location, selecting a projection unit (5) (page 8, lines 23-24) comprised of at least a projector (3) (page 8, lines 23-24) for projecting a distorted image (16), (page 9, lines 22-23) and moving the at least one projector by operating a mechanism (54) (page 9, lines 3-5) comprising the at least one projector mounted on a moveable portion of the mechanism, wherein the mechanism is adapted for providing translational movement and rotational movement (page 7, lines 18-23) of the at least one projector to provide the substantially undistorted image upon the surface at the location.

Independent claim 30 is directed to a method for providing a substantially undistorted image (11) (page 9, line 31 – page 10, line 2) upon a surface (page 10, lines 16-17). The method includes sensing a request from a user (1) (page 8, lines 15-16) for a projection at a location, selecting a projection unit (5) (page 8, lines 23-24) comprised of at least a projector (3) (page 8, lines 23-24) for projecting a distorted image (16) (page 9, lines 22-23), moving the at least one projector by operating a mechanism (54) (page 9, lines 3-5) comprising the at least one projector mounted on a moveable portion of the mechanism, wherein the mechanism is adapted for providing translational movement and rotational movement (page 7, lines 18-23) of the at least one projector to provide the substantially undistorted image upon the surface (12) (page 10, lines 16-17) at the location, and coordinating the position of the at least one projector (3) with a position of at least another projector (5-2)(page 11, lines 23-25) wherein the projection unit produces a first portion of the distorted image and the at least another projection unit produces another portion of the distorted image.

Independent claim 31 is directed to a method for calibrating a positioning system (50)(page 9, line 1) for a projection unit (5) comprised of at least a projector (3)(page 8, lines 23-24) adapted for projecting a distorted image (16)(page 9, lines 22-23). The positioning system provides a substantially undistorted image (11)(page 9, line 31 – page 10, line 2) to a user (1)(page 13, line 24). The method includes loading a calibration image (page 17, line 28) into the at least one projector, moving the at least one projector to a location to project the calibration image upon a target surface (12)(page 10, lines 16-17), adjusting settings of the at least one projector to produce a calibration image that is substantially undistorted upon the target surface (12)(page 10, lines 16-17), recording the settings for the at least one projector at the location (page 18, line 2), associating the settings with the target surface (page 18, lines 2-3) to produce a set of geometric model data (72)(page 18, line 3), storing the set of geometric model data (page 18, lines 3-4); and, and repeating the loading, moving, adjusting, recording, associating and storing for a plurality of positions of the at least one projector.

Independent claim 32 is directed to a method to provide a substantially undistorted image (11) (page 9, line 31 – page 10, line 2) upon a surface (page 10, lines 16-17) at a location. The method includes providing a projection unit (5)(page 8, lines 23-24) coupled to a positioning system (50)(page 9, line 1), the projection unit comprised of at least a projector (3)(page 8, line 23-24) for providing an image, loading setting layout information (72)(page 18, line 3) into a positioning controller (53)(page 16, line 19-24) for operating the positioning system, positioning the at least one projector at a location by referring to the setting layout information, referring to the setting layout information (page 16, lines 19-24) to determine projection settings for the at least one projector, and adjusting the settings of the at least one projector to the projection settings to produce the image upon the surface (page 16, lines 29-31).

Independent claim 33 is directed to a method for adjusting at least one input setting of an interaction recognition system (4) coupled to a positioning system (50)(page 9, line 1). The method includes providing a positioning system comprising at least one mount (52)(page 9, lines 1-2) adapted for mounting a projection unit (5)(page 8, lines 23-24) and at least one other mount (page 5, lines 1-2) for positioning the interaction recognition system, wherein the interaction recognition system (4)(page 8, lines 13-15) provides for a user input in response to an image projected by the projection unit (page 7, lines 10-12), loading area layout information (72)(page 18, line 3) into a positioning controller for operating the positioning system, positioning the interaction recognition system at a location by referring to the area layout information (page 16, lines 19-24), referring to the area layout information to optimize the at least one input setting for the interaction recognition system (page 5, line 9), and adjusting the at least one input setting of the interaction recognition system.

Independent claim 34 is directed to a computer program stored on a computer readable media, the program comprising instructions for positioning a projection unit (5)(page 8, lines 23-24) to produce a substantially undistorted image (11)(page 9, line 31 – page 10, line 2). The instructions include sensing a request from a user for production of an image at a location (page 5, line 15), positioning the projection unit to provide the substantially undistorted image upon a surface (12) at the location (page 5, line 17), wherein positioning comprises referring to a stored geometric model (72) for the location to produce the substantially undistorted image in accordance with the geometric model (page 16, lines 19-24).

Independent claim 35 is directed to a positioning system (50)(page 9, line 1). The positioning system includes a mounting means (52)(page 7, lines 17-18; page 9, lines 1-14; page 11, line 26; page 12, lines 26-27; page 15, lines 5-14) for mounting a projection

means comprised of at least an image projecting means (3)(page 8, lines 23-24) for projecting a distorted image (16)(page 9, lines 22-23); wherein the mounting means is coupled to positioning means for providing translational movement and rotational movement (page 7, lines 18-23) of the projection means to produce a substantially undistorted image (11) from the distorted image (16).

Independent claim 37 is directed to a projection system comprising at least one projection unit (5)(page 8, lines 23-24) comprised of at least a projector (3)(page 8, lines 23-24) for projecting a distorted image (16)(page 9, lines 22-23), the at least one projector mounted to at least one mount (52)(page 9, lines 1-2) that is coupled to a mechanism providing translational movement and rotational movement for positioning the at least one projector to produce a substantially undistorted image from the distorted image (11).

Independent claim 40 is directed to an image projection system (50)(page 9, line 1) comprising a controller (20)(page 8, lines 23-30) coupled to a positioning apparatus (54) for positioning a projection unit in three-dimensional space, the system for producing a substantially undistorted image (11)(page 9, line 31 – page 10, line 2) at a specified location, the controller being responsive to stored geometric model (72) for the location to cause the projection unit to provide the substantially undistorted image.

(6) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

- A. The first ground for rejection (Issue A) presented for review by the Board is the propriety of the Examiner's rejection of claims 1-3, 5, 6, 15-32 and 34-40 under 35 USC 103(a) as being unpatentable over Miyamoto et al. (5,114,224) in view of Raskar (6,793,350) and Connelly et al. (2003/0202156).

B. The second ground for rejection (Issue B) presented for review by the Board is the propriety of the Examiner's rejection of claims 7-13 and 33 under 35 USC 103(a) as being unpatentable over Miyamoto et al. in view of Raskar and Connelly et al. in further view of Pinhanez (6,431,711).

(7) ARGUMENT

ISSUE A:

ARGUMENT 1: MIYAMOTO DOES NOT TEACH PROJECTING A DISTORTED IMAGE, AND COMBINING THE TEACHINGS OF MIYAMOTO WITH RASKAR AND CONNELLY, SUCH A COMBINATION DEEMED TO BE INAPPROPRIATE, WOULD RENDER SUCH A COMBINATION UNSATISFACTORY FOR ITS INTENDED PURPOSE AS RECITED IN EACH OF INDEPENDENT CLAIMS 1, 24, 30, 31, 32, 34, 35, 37 AND 40.

It is well established that if a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

The Examiner asserted in the final Office Action that Miyamoto teaches "At least one mount (10) for mounting a projection unit, the unit comprised of at least a projector (11) for projecting a distorted image (since it is designed for projecting on a curved surface it must project at least a slightly distorted image since a non-distorted flat image would not appear correct on a curved surface (see column 1 line 60 through column 2 line 9 of Raskar et al. (US 6,793,350) which teaches that even for large curved displays (such as that taught by Miyamoto) that a pre-distorted image is necessary to allow a viewer to view an undistorted image and the rest of **Raskar teaches a preferred method of achieving an undistorted image in various environments such as that taught by Miyamoto** and accordingly it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use such a method in the projection/positioning system of Miyamoto so that an undistorted image is viewable by a viewer at an [sic] position)". (emphasis added)

Appellants respectfully assert that Raskar does not teach a method, let alone a preferred method, for achieving an undistorted image in an environment such as that taught by Miyamoto. Specifically, the combination of the image distortion methodology taught by Raskar with the projection/positioning system of Miyamoto, such a combination neither suggested nor deemed appropriate, would render the combination inoperable and unsatisfactory for its intended purpose.

As Miyamoto makes clear in the Abstract, “The image projecting apparatus projects the image by **automatically tracking the position of the moving light emitting member** or the reflective medium. Consequently, the image can be **continually projected** at the predetermined position, **automatically tracking the moving object** such as an airship or a balloon, so that it can be available as an effective advertising medium or news.” (emphasis added). As explicitly stated, Miyamoto is directed to the continual projection of an image on a moving object. As Fig. 1 and the accompanying description make clear, the object on which the image is projected is in motion with respect to the stationary mounted projector.

In contrast, Raskar teaches the projection of images onto a curved surface wherein the orientation and position of the projector is fixed with respect to the surface onto which the image is projected. Fig. 1 of Raskar is “a flow diagram of pre-processing steps used by a method for projecting images onto a curved surface according to the invention”. As Raskar teaches at col. 4, line 57 – col. 5, line 11:

As shown in FIG. 1, the basic steps of our pre-processing method 100 are as follows. The details of these steps are described below. **For each projector i, a predetermined image 101, e.g., a structured pattern in the form of a checkerboard, is projected 110 onto the quadric surface.**

In step 120, features in images acquired of the predetermined image 101 by the stereo camera 102 are detected, and 3D points are reconstructed, i.e., correspondences 103, on the quadric surface, which correspond with the features of the predetermined. Then, the quadric surface, Q 104 is fitted 130 to the detected correspondences.

For each projector i, a pose 105 of the projector, with respect to the camera, is determined 140 using the correspondence between projector pixels and 3D coordinates of points on the surface illuminated by the pixels. Determine 150 the quadric transfer function, .PSI_i and its inverse .PSI_{ji}, between the camera c_o and projector i. Then, determine 160 intensity blending weights, .PHI., in regions where the projected images overlap. At this point, a projector image can be projected 200 by

warping, blending and projecting to appear as an undistorted output image 171 on the quadric surface.

As is evident from Fig. 1 and its description, projecting an image via the method of Raskar requires the performance of pre-processing method 100. Pre-processing method 100 requires the projection of a structured pattern in the form of a checkerboard onto the surface to which the projected image will be directed. A stereo camera is utilized to fit a quadratic surface and the position, or “pose”, of each projector with respect to the camera and hence, to the quadratic surface, is determined. Once the position of each projector with respect to the quadratic surface is determined, a quadratic transfer function is derived and “a projector image can be projected 200 by warping, blending and projecting to appear as an undistorted output image 171 on the quadric surface”. As illustrated in Figs. 3 and 4, and the accompanying descriptions, Raskar is directed to projecting images onto curved surfaces, such as concave and convex domes, where the projector or projectors are fixed with respect to the surface upon which they project. As should be apparent, if the relationship between the position of a projector and the quadratic surface of Raskar were changed, it would be necessary to repeat pre-processing method 100 in order to derive a new projector position and quadratic transfer function for warping the image.

As noted above, Miyamoto teaches “**automatically tracking the position of the moving light emitting member**” so that “the image can be **continually projected at the predetermined position**”. It is evident that combining the teachings of Raskar with those of Miyamoto would render Miyamoto unsatisfactory for its intended purpose, specifically, **continually projecting an image on a moving object**. Specifically, were the method of Raskar to be combined with Miyamoto, such a combination neither suggested nor deemed appropriate, every motion of the moving object of Miyamoto would require the projection of the checkerboard pattern and subsequent pre-processing steps of Raskar, thus negating the possibility of continually projecting the image at a predetermined position. It is further noted that additional combination of the teachings of Miyamoto and Raskar with the teachings of Connelly, such a combination neither suggested nor deemed appropriate, would not result in a combination satisfactory for its intended purpose. For this reason alone, the rejection of claims 1, 24, 30, 31, 32, 34, 35, 37 and 40, relying upon an impermissible combination of the teachings of Miyamoto and Raskar, must be withdrawn. As all of dependent claims 2-3, 5, 6, 15-23, 25-29, 36, and 38-39 depend upon claims 1, 24, 30, 31, 32, 34, 35, 37 and 40 their rejections must likewise be withdrawn.

ISSUE A:

ARGUMENT 2: MIYAMOTO, ALONE OR IN COMBINATION WITH RASKAR AND CONNELLY ET AL., DOES NOT TEACH PROVIDING TRANSLATIONAL MOVEMENT AND ROTATIONAL MOVEMENT TO PRODUCE A SUBSTANTIALLY UNDISTORTED IMAGE AS RECITED IN EACH OF INDEPENDENT CLAIMS 1, 24, AND 30.

It is well established that, to establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). “All words in a claim must be considered in judging the patentability of that claim against the prior art.” *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). Furthermore, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending there from is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

Claim 1 recites, in part:

... providing translational movement and rotational movement for adjusting one of a position and an orientation of the projection unit to produce from the distorted image a substantially undistorted image on a surface. (emphasis added).

With respect to claim 1, the Examiner asserted in the final Office Action that Miyamoto et al. teach “projecting a distorted image ... wherein the at least one mount is coupled to a mechanism for providing rotational movement for adjusting one of a position and an orientation of the projection unit to produce from the distorted image a substantially undistorted image on a surface. (as stated above with regards to Raskar it is obvious that a undistorted image would be produced, in general people do not purposely make highly distorted images when advertising which is what Miyamoto is designed for.)”

Appellants respectfully assert that the Examiner is in error. As argued previously and detailed below, Miyamoto makes no mention of a distorted image, neither teaches nor suggests a motivation for projecting a distorted image, and lacks a teaching of a mechanism by which Miyamoto could distort an image. However, assuming, arguendo,

that Miyamoto were to teach projecting a distorted image, Miyamoto does not teach “providing translational movement and rotational movement for adjusting one of a position and an orientation of the projection unit to produce from the distorted image a substantially undistorted image on a surface” as claimed.

As Miyamoto states in the Abstract, “The image projecting apparatus projects the image by automatically tracking the position of the moving light emitting member of the reflective medium. Consequently, **the image can be continually projected at the predetermined position**, automatically tracking the moving object such as an airship or a balloon, so that it can be available as an effective advertising medium or news.” (emphasis added). As is evident, what rotational movement of the projection unit of Miyamoto is taught to be performed to track a moving object, and not “**to produce from the distorted image a substantially undistorted image on a surface**” as claimed.

It is therefore evident that Miyamoto does not teach “**a projector for projecting a distorted image; wherein the at least one mount is coupled to a mechanism for providing translational movement and rotational movement for adjusting one of a position and an orientation of the projection unit to produce from the distorted image a substantially undistorted image on a surface**” as claimed.

The Examiner cited Connelly as teaching “in figure 1a, a mechanism for providing translational movement for adjusting the position of a projection unit mounted on it. Connelly teaches in paragraphs 9 and 10 that such a translational movement system allows for the use of multiple projectors in the same location and also more versatility in positioning the projector allowing for less keystone distortion.” Appellants respectfully assert that Connelly does not teach a projector for projecting a distorted image, nor is there taught “**a mechanism for providing translational movement and rotational movement for adjusting one of a position and an orientation of the projection unit to produce from the distorted image a substantially undistorted image on a surface**” as claimed.

Appellants note that Raskar teaches, at col. 10, lines 14-16, “In our case, instead of pre-distorting the geometry, we pre-distort the image space projection.” However, it is the use of the image space projection, and not a result of any translational or rotational movement of the projection unit, that results in the projected image of Raskar.

As a result, were the teachings of Miyamoto, Connelly, and Raskar to be combined, such a combination neither being suggested nor deemed appropriate, the resulting combination would not teach the elements of claim 1. Specifically, were the

rotational movement of Miyamoto and the translational movement aspects of Connelly combined with the teachings of Raskar, the resulting system would not operate so as to provide “translational movement and rotational movement for adjusting one of a position and an orientation of the projection unit” that produces “from the distorted image a substantially undistorted image on a surface” as claimed. Rather, the creation of any substantially undistorted image on a surface would, presumably, arise from the use of the pre-distortion of an image space projection of Raskar.

It is therefore evident that the Examiner is in error when asserting that the combination of Miyamoto, Connelly, and Raskar, such a combination neither being suggested nor deemed appropriate, teaches “providing translational movement and rotational movement for adjusting one of a position and an orientation of the projection unit to produce from the distorted image a substantially undistorted image on a surface”. For this reason alone, rejection of claim 1 must be withdrawn. As claims 24, 30, 35 and 37 likewise recite providing translational and rotational movement to produce a substantially undistorted image, the rejections of these claims must likewise be withdrawn. In addition, as claims 7-8 depend upon claim 1, the rejection of claims 7-8 must likewise be withdrawn.

ISSUE A:

ARGUMENT 3: MIYAMOTO DOES NOT TEACH PROJECTING A DISTORTED IMAGE, AND DOES NOT PROVIDE A MOTIVATION FOR COMBINATION WITH THE TEACHINGS OF RASKAR AND CONNELLY ET AL. TO DO SO, AS RECITED IN EACH OF INDEPENDENT CLAIMS 1, 24, 30, 31, 35, AND 37.

“The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference.... Rather, the test is what the combined teachings of those references would have suggested to those of ordinary skill in the art.” *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). See also *In re Sneed*, 710 F.2d 1544, 1550, 218 USPQ 385, 389 (Fed. Cir. 1983).

From the first citation of the Examiner to Raskar in the Office Action of July 14, 2005 through the final Office Action of December 29, 2006 and the Advisory Action, the Examiner has repeatedly asserted, often in the same sentence, that Miyamoto both teaches the projection of a distorted image and, in contradiction, that it would be obvious to combine the teachings of Miyamoto with additional art, such as Raskar, in order to teach

this element. Specifically, the Examiner asserted that Miyamoto “must project at least a slightly distorted image” (emphasis added) and “that a pre-distorted image is necessary to allow a viewer to view an undistorted image and ... Raskar teaches a preferred method of achieving an undistorted image ... and accordingly it would have been obvious to one of ordinary skill in the art at the time the invention was made to use such a method in the projection/positioning system of Miyamoto so that an undistorted image is viewable by a viewer at an [sic] position.”

As is evident, the Examiner makes no reference to any teaching or recitation of Miyamoto as disclosing the projection of a distorted image. Rather, in lieu of citing an identifiable disclosure of Miyamoto, the Examiner asserts that Miyamoto simply “must” disclose the projection of a distorted image. Appellants respectfully assert that Miyamoto nowhere teaches or otherwise discloses the projection of a distorted image, and as described more fully below, provides no motivation to project a distorted image. As Miyamoto does not teach or disclose the projection of a distorted image, nor does the Examiner offer any citation in support of such a teaching, the Appellants herein address the Examiner’s assertion that it would have been obvious to combine the teachings of Miyamoto and Raskar, such a combination neither suggested nor deemed appropriate.

In the final Office Action of December 29, 2005, the Examiner asserted that “see column 1 line 60 through column 2 line 9 of Raskar et al. (US 6,793,350) which teaches that even for large curved displays (such as that taught by Miyamoto) that a pre-distorted image is necessary to allow a viewer to view an undistorted image”. In the Advisory Action of April 14, 2006 the Examiner further reasserted that “The office disagrees, as taught by Raskar it was well known in the art at the time the invention was made that when projecting on curved surfaces the projected image must be pre-distorted”. The Examiner further states that “Accordingly, it would have been obvious to one of ordinary skill in the art that Miyamoto does indeed project a distorted image and it would be obvious for it to do so by using the method of Raskar which has been shown to be superior to other prior art methods.”

Appellants respectfully submit that the Examiner makes at least two clear errors in the above assertions. First, Raskar does not teach that it is a necessity to pre-distort an image projected on a curved surface as when the Examiner asserts “that when projecting on curved surfaces the projected image **must** be pre-distorted”. (emphasis added) In fact Raskar teaches the opposite. Specifically, Raskar makes clear that viewing a projected

image almost always involves a perceived distortion that is both unavoidable and acceptable. Therefore, while Raskar teaches a method for minimizing distortion of an image projected on a curved surface, Raskar does not teach that it is a requirement that every projection of an image onto a curved surface undergo distortion. As Raskar recites, at the Examiner's citation of col. 1, line 66 – col. 2, line 10:

One problem is that when 3D images are displayed on a curved screen, the images are perspectively correct from only a single point in space. This 3D location is known as the virtual viewpoint or 'sweet-spot'. As the viewer moves away from the sweet-spot, the images appear distorted. For very large display screens and many view points, it is difficult to eliminate this distortion. However, in real-world applications, viewers would like to be at the exact same place where the projectors ideally need to be located. In addition, placing projectors at the sweet-spot means using a very wide-field of view projectors, which are expensive and tend to have excessive radial or 'fish-eye' distortion.

As Raskar makes abundantly clear, when 3D images are displayed on a curved screen, the images will appear distorted if viewed from anywhere except from the single point in space known as the "sweet spot". Raskar correctly states this as a fact. Being an immutable result of the application of physics, Raskar engages in no attempt to change this fact. What Raskar does do is make an observation. Specifically, the image projector should ideally be located at the sweet spot. However, such a placement prevents viewers from viewing the image from the sweet spot. Note that the sweet spot is described as the only position from which an image can be viewed without the image appearing to be distorted. As such a spot is an infinitesimal singularity, Raskar therefore makes clear that all viewing of a projected image, with the exception of that occurring exactly at the sweet spot, involves some distortion.

The rest of Raskar is directed, generally, to teaching a method of projecting overlapping portions of an image each portion projected from a different projector to form a single image on a curved surface. By so doing, the projectors can be moved away from the sweet spot. In addition, as each projector is projecting only a portion of the image, the projectors need not be wide-field of view projectors.

It is therefore clear that the distortion to which Raskar refers is that which is perceived by a viewer as a result of the viewer's position. It must be emphasized that, as Raskar states, there is no viewer distortion when viewed from the sweet spot. As is

evident, this distortion described by Raskar is not related to any distortion, "pre" or otherwise, of the projected image.

Second, the Examiner is clearly in error when asserting that "it would have been obvious to one of ordinary skill in the art that Miyamoto does indeed project a distorted image and it would be obvious for it to do so by using the method of Raskar which has been shown to be superior to other prior art methods".

Appellants respectfully point out that Miyamoto makes no mention of a distorted image, neither teaches nor suggests a motivation for projecting a distorted image, and lacks a teaching of a mechanism by which Miyamoto could distort an image.

Further, and as was argued above, even if Miyamoto were to be combined with Raskar (which is not admitted is suggested), the resulting combination would be inoperable. For this reason alone, rejection of claim 1 must be withdrawn. As claims 24, 30, 31, 35, and 37 likewise rely upon a combination of Miyamoto and Raskar, the rejections of these claims must likewise be withdrawn.

Appellants note that, with respect to the Examiner's rejections of claims 35-40, the Examiner asserted basis for rejection consists in its entirety of "See above". As discussed above, the rejection of claim 35 must be withdrawn. Claim 36 depends upon claim 35 and therefore the rejection of claim 36 must likewise be withdrawn. Claim 37 recites a projector for "for projecting a distorted image". For the reasons discussed above, the rejection of claim 37 must be withdrawn. As claims 38-39 depend upon claim 37, the rejections of claims 38-39 must likewise be withdrawn.

ISSUE A:

ARGUMENT 4: MIYAMOTO, ALONE OR IN COMBINATION WITH RASKAR AND CONNELLY ET AL., DOES NOT TEACH AT LEAST ONE PROJECTOR COUPLED TO A CONTROLLER FOR GENERATING A DISTORTED IMAGE AS RECITED IN DEPENDENT CLAIMS 5 AND 6.

The Examiner asserted, with regards to claim 5, that "The projector is coupled to a controller (100)" and, with regards to claim 6, "The controller is remote".

Claim 5 recites:

5. The positioning system as in claim 1, wherein the at least one projector is coupled to a controller for generating the distorted image.

As is evident, claim 5 explicitly recites a controller **for generating the distorted image**. As discussed at length above, Miyamoto nowhere discloses the generation or projection of a distorted image. Furthermore, as noted above, the Examiner nowhere cites any disclosure of Miyamoto as teaching such an element. As a result, the “controller (100)” of Miyamoto is most emphatically not a controller “for generating the distorted image” as recited in claim 5. For this reason alone, the rejection of claim 5 must be withdrawn. As claim 6 depends upon claim 5, the rejection of claim 6 must likewise be withdrawn.

ISSUE A:

ARGUMENT 5: MIYAMOTO, ALONE OR IN COMBINATION WITH RASKAR AND CONNELLY ET AL., DOES NOT TEACH THAT THE POSITION CONTROLLER COMPRIMES A SOURCE OF GEOMETRIC MODEL INFORMATION AS RECITED IN DEPENDENT CLAIM 18.

The Examiner asserted, with regards to claim 18, that “As described in column 4 of Miyamoto, geometric information is used in determining the projector position. (Cartesian coordinates are a type of geometric information).”

Claim 18 recites:

18. The positioning system as in claim 17, wherein the positioning controller comprises a source of geometric model information.

As is evident, claim 18 recites a source of geometric **model** information. While taking no position on the Examiner’s assertion that Cartesian coordinates are a type of geometric information, Appellants respectfully assert that Miyamoto makes no disclosure, nor does the Examiner assert otherwise, of geometric **model** information as claimed. For this reason alone, the rejection of claim 18 must be withdrawn. Appellants note that Raskar discloses at block 140 determining the position of a projector with respect to the camera. As discussed above, Raskar teaches determining the position of a stationary projector with respect to a camera based, in part, on a quadratic fit of a curved surface. However, Raskar does not disclose controlling the position of the projector as recite din claim 17 and on which claim 18 depends.

Appellants note that, with respect to the Examiner's rejections of claim 40, the Examiner asserted basis for rejection consists, in its entirety, of "See above". Appellants note that claim 40 recites "the controller being responsive to stored geometric model". For the reasons discussed above with reference to claim 18, the rejection of claim 40 must likewise be withdrawn.

ISSUE A:

ARGUMENT 6: MIYAMOTO, ALONE OR IN COMBINATION WITH RASKAR AND CONNELLY ET AL., DOES NOT TEACH ASSOCIATING THE SETTINGS WITH THE TARGET SURFACE TO PRODUCE A SET OF GEOMETRIC MODEL DATA, STORING THE SET OF GEOMETRIC MODEL DATA, AND REPEATING AS RECITED IN INDEPENDENT CLAIM 31.

The Examiner asserted that "Raskar teaches in figure 1 a method for projecting an undistorted image upon a curved image with more than [sic] one projector, which includes projecting a structure light pattern (calibration image as is claimed in applicant's claim 31)".

Claim 31 recites, in relevant part:

... moving the at least one projector to a location to project the calibration image upon a target surface;
associating the settings with the target surface to produce a set of geometric model data;
storing the set of geometric model data; and,
repeating the loading, moving, adjusting, recording, associating and storing for a plurality of positions of the at least one projector.

Appellants respectfully note that, as is clearly illustrated in Fig. 1 of Raskar, and the accompanying explanatory text, the calibration process of Raskar operates to produce "an undistorted output image 171 on the quadratic surface" (col. 5, lines 10-11). However, Raskar nowhere teaches the repeated moving of the projector to a plurality of positions as claimed. As discussed above, the projectors of Raskar are not moved after performing pre-processing. For this reason alone, the rejection of claim 31 must be withdrawn.

ISSUE A:

ARGUMENT 7: MIYAMOTO, ALONE OR IN COMBINATION WITH RASKAR AND CONNELLY ET AL., DOES NOT TEACH POSITIONING THE AT LEAST ONE PROJECTOR AT A LOCATION BY REFERRING TO THE SETTING LAYOUT INFORMATION AS RECITED IN INDEPENDENT CLAIM 32.

With respect to claim 32, the Examiner asserted that “See above where the method of using the projector to make an undistorted image upon a surface is obvious in light of the projector that does so”. In addition to the arguments discussed above, Appellants note that claim 32 recites “positioning the at least one projector at a location by referring to the setting layout information”. None of the cited art disclose this element, nor does the Examiner assert that they do. For this reason alone, the rejection of claim 32 must be withdrawn.

ISSUE A:

ARGUMENT 8: MIYAMOTO, ALONE OR IN COMBINATION WITH RASKAR AND CONNELLY ET AL., DOES NOT TEACH POSITIONING THE PROJECTION UNIT TO PROVIDE A SUBSTANTIALLY UNDISTORTED IMAGE AT A LOCATION BY REFERRING TO A STORED GEOMETRIC MODEL FOR THE LOCATION AS RECITED IN INDEPENDENT CLAIM 34.

With respect to claim 34, the Examiner asserted that “Part 4 is basically a computer that executes a computer program for positioning a projection unit to provide a substantially undistorted image upon a surface (see above for the method of doing so).”

Claim 34 recites, in relevant part:

... positioning the projection unit to provide the substantially undistorted image upon a surface at the location, wherein positioning comprises **referring to a stored geometric model** for the location to produce the substantially undistorted image **in accordance with the geometric model.** (emphasis added)

Appellants respectfully assert that none of the recited art individually or in combination, such a combination neither suggested nor deemed appropriate, teach or suggest **positioning** the projection unit by referring to a stored geometric model or producing a substantially undistorted image in accordance with the geometric model as claimed. Appellant further note that the Examiner does not provide a citation or any other

reference to indicate otherwise. For the reasons discussed above, the rejection of claim 34 must be withdrawn.

ISSUE B:

ARGUMENT 1: MIYAMOTO, ALONE OR IN COMBINATION WITH RASKAR, CONNELLY ET AL., AND PINHANEZ, DOES NOT TEACH POSITIONING THE INTERACTION SYSTEM BY REFERRING TO AN AREA LAYOUT INFORMATION AS RECITED IN INDEPENDENT CLAIM 33.

With regards to claim 33, the Examiner asserted simply that “The method of using the projection system of Miyamoto in view of Raskar and Connelly and Pinhanez is obvious.” As discussed above, there is no motivation provided in Miyamoto to combine the teachings of Miyamoto and Raskar. In addition, Appellants note that claim 33 recites “positioning the interaction recognition system at a location by referring to the area layout information.” Appellants respectfully assert that none of the cited art, taken alone or in combination, such a combination neither suggested nor deemed appropriate, discloses this element nor does the Examiner provide a citation or reference to refute this assertion. For these reasons, the rejection of claim 33 must be withdrawn.

CONCLUSION

For at least the above reasons, the Applicant/Appellant contends that all of independent claims 1, 24, 30-35, 37, and 40 are patentable over Miyamoto, Raskar, Connelly, and Pinhanez alone or in combination, such combination deemed inappropriate, and the rejections of these claims must be withdrawn. As all of claims 2-13, 15-23, 25-29, 36, and 38-39 are dependent upon claims 1, 24, 35, and 37, they are likewise patentable for at least this one reason alone and the rejections of these claims must likewise be withdrawn. The Applicant/Appellant respectfully requests the Board reverse the final rejection in the Office Action of December 29, 2005, and further that the Board rule that the pending claims are patentable over the cited art.

Respectfully submitted:

HARRINGTON & SMITH, LLP



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29 Sep 06
Date

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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CLAIMS APPENDIX

1. A positioning system comprising,
at least one mount for mounting a projection unit, the projection unit comprised of at least a projector for projecting a distorted image; wherein the at least one mount is coupled to a mechanism for providing translational movement and rotational movement for adjusting one of a position and an orientation of the projection unit to produce from the distorted image a substantially undistorted image on a surface.
2. The positioning system as in claim 1, wherein the projection unit comprises a redirection device.
3. The positioning system as in claim 2, wherein the redirection device comprises a mirror.
4. The positioning system as in claim 2, wherein the redirection device comprises at least one of a lens, an optical fiber and a prism.
5. The positioning system as in claim 1, wherein the at least one projector is coupled to a controller for generating the distorted image.
6. The positioning system as in claim 5, wherein the controller comprises one of a remote controller, a controller integrated with the projection unit and a controller mounted with the projection unit.
7. The positioning system as in claim 1, wherein one of the distorted image and the substantially undistorted image comprise an interactive region for a user interaction.
8. The positioning system as in claim 7, wherein the user interaction comprises an instruction for operation of external equipment.

9. The positioning system as in claim 1, wherein one of the mount and at least another mount is adapted for mounting an interaction recognition system.
10. The positioning system as in claim 1, wherein the projection unit comprises an interaction recognition system.
11. The positioning system as in claim 9, wherein the interaction recognition system comprises apparatus for detecting a user interaction.
12. The positioning system as in claim 9, wherein the interaction recognition system comprises at least one camera.
13. The positioning system as in claim 9, wherein the interaction recognition system comprises a voice recognition system.
14. (cancelled)
15. The positioning system as in claim 1, wherein the mechanism is comprised of at least one of a telescoping mount, a scissors lift, an articulating arm, a kinematic device and a rail system.
16. The positioning system as in claim 1, wherein the mechanism is adapted for attaching to a fixed support.
17. The positioning system as in claim 1, comprising a positioning controller for controlling the position of the at least one projector.

18. The positioning system as in claim 17, wherein the positioning controller comprises a source of geometric model information.
19. The positioning system as in claim 1, comprising tracking and sensing equipment for identifying a position for the at least one projector.
20. The positioning system as in claim 1, wherein the system is adapted for positioning the at least one projector with two degrees of freedom.
21. The positioning system as in claim 1, wherein the system is adapted for positioning the at least one projector with three degrees of freedom.
22. The positioning system as in claim 1, wherein the system is adapted for orienting the at least one projector with two degrees of freedom.
23. The positioning system as in claim 1, wherein the system is adapted for orienting the at least one projector with three degrees of freedom.
24. A method for providing a substantially undistorted image upon a surface, the method comprising:
 - sensing a request from a user for a projection at a location;
 - selecting a projection unit comprised of at least a projector for projecting a distorted image; and,
 - moving the at least one projector by operating a mechanism comprising the at least one projector mounted on a moveable portion of the mechanism, wherein the mechanism is adapted for providing translational movement and rotational movement of the at least one projector to provide the substantially undistorted image upon the surface at the location.
25. The method as in claim 24, wherein sensing comprises identifying a request from at least one of equipment for automatically entering the request and equipment for manually entering the request.

26. The method as in claim 24, wherein operating the mechanism comprises one of manually operating the mechanism and automatically operating the mechanism.
27. The method as in claim 24, wherein positioning comprises locating the projection unit to provide for an image substantially free from occlusion.
28. The method as in claim 24, comprising coordinating position of the at least one projector with a position of at least an interaction recognition system.
29. The method as in claim 24, comprising coordinating the position of the at least one projector with a position of at least another projector.
30. A method for providing a substantially undistorted image upon a surface, the method comprising:
 - sensing a request from a user for a projection at a location;
 - selecting a projection unit comprised of at least a projector for projecting a distorted image;
 - moving the at least one projector by operating a mechanism comprising the at least one projector mounted on a moveable portion of the mechanism, wherein the mechanism is adapted for providing translational movement and rotational movement of the at least one projector to provide the substantially undistorted image upon the surface at the location; and
 - coordinating the position of the at least one projector with a position of at least another projector wherein the projection unit produces a first portion of the distorted image and the at least another projection unit produces another portion of the distorted image.

31. A method for calibrating a positioning system for a projection unit comprised of at least a projector adapted for projecting a distorted image, the positioning system for providing a substantially undistorted image to a user, the method comprising:
 - loading a calibration image into the at least one projector;
 - moving the at least one projector to a location to project the calibration image upon a target surface;
 - adjusting settings of the at least one projector to produce a calibration image that is substantially undistorted upon the target surface;
 - recording the settings for the at least one projector at the location;
 - associating the settings with the target surface to produce a set of geometric model data;
 - storing the set of geometric model data; and,
 - repeating the loading, moving, adjusting, recording, associating and storing for a plurality of positions of the at least one projector.
32. A method to provide a substantially undistorted image upon a surface at a location, the method comprising:
 - providing a projection unit coupled to a positioning system, the projection unit comprised of at least a projector for providing an image;
 - loading setting layout information into a positioning controller for operating the positioning system;
 - positioning the at least one projector at a location by referring to the setting layout information;
 - referring to the setting layout information to determine projection settings for the at least one projector; and,
 - adjusting the settings of the at least one projector to the projection settings to produce the image upon the surface.

33. A method for adjusting at least one input setting of an interaction recognition system coupled to a positioning system, the method comprising:
 - providing a positioning system comprising at least one mount adapted for mounting a projection unit and at least one other mount for positioning the interaction recognition system, wherein the interaction recognition system provides for a user input in response to an image projected by the projection unit;
 - loading area layout information into a positioning controller for operating the positioning system;
 - positioning the interaction recognition system at a location by referring to the area layout information;
 - referring to the area layout information to optimize the at least one input setting for the interaction recognition system; and,
 - adjusting the at least one input setting of the interaction recognition system.
34. A computer program stored on a computer readable media, the program comprising instructions for positioning a projection unit to produce a substantially undistorted image, the instructions for:
 - sensing a request from a user for production of an image at a location;
 - positioning the projection unit to provide the substantially undistorted image upon a surface at the location, wherein positioning comprises referring to a stored geometric model for the location to produce the substantially undistorted image in accordance with the geometric model.
35. A positioning system, comprising:
 - mounting means for mounting a projection means comprised of at least an image projecting means for projecting a distorted image; wherein the mounting means is coupled to positioning means for providing translational movement and rotational movement of the projection means to produce a substantially undistorted image from the distorted image.

36. The positioning system as in claim 35, wherein the positioning means comprises means for moving the image projecting means through a range of movement comprising between two degrees of freedom and six degrees of freedom.
37. A projection system, comprising:
 - at least one projection unit comprised of at least a projector for projecting a distorted image, the at least one projector mounted to at least one mount that is coupled to a mechanism providing translational movement and rotational movement for positioning the at least one projector to produce a substantially undistorted image from the distorted image.
38. The projection system as in claim 37, wherein the projection unit comprises a controller for generating the distorted image coupled to the at least one projector.
39. The projection system as in claim 37, wherein one of the substantially undistorted image and the distorted image comprises an interactive region.
40. An image projection system comprising a controller coupled to a positioning apparatus for positioning a projection unit in three-dimensional space, the system for producing a substantially undistorted image at a specified location, the controller being responsive to stored geometric model for the location to cause the projection unit to provide the substantially undistorted image.

END OF CLAIMS

(9) EVIDENCE APPENDIX

There is no evidence submitted pursuant to 37 C.F.R. §§1.130, 1.131, or 1.132 or entered by the Examiner and relied upon by Appellant.

(10) RELATED PROCEEDING APPENDIX

There are no known decisions rendered by a court or the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of 37 C.F.R. §41.37.